

CLAIMS

We claim:

- 1 1. A slurry for chemical mechanical polishing (CMP) of a copper or silver
2 containing film, comprising:
 - 3 a solution providing at least one reagent for reacting with said copper or
4 silver film to form a soft layer on a surface of said film, said soft layer having a
5 hardness less than said copper or silver film, said slurry adapted to polish said soft
6 layer using either no particles or particles which are softer than said copper or silver
7 film.
- 1 2. The slurry of claim 1, wherein said soft layer comprises a copper or
2 silver halide.
- 1 3. The slurry of claim 2, wherein said copper or silver halide comprises
2 copper iodide (CuI) or silver iodide (AgI).
- 1 4. The slurry of claim 1, wherein said slurry includes a plurality of said
2 soft particles.

1 5. The slurry of claim 4, wherein said plurality of particles comprise
2 polymer or nano-porous particles.

1 6. The slurry of claim 5, wherein said plurality of particles comprise at
2 least one selected from the group consisting of polystyrene,
3 polytetrafluoroethylene, polyamide, silver and porous silica.

1 7. The slurry of claim 1, wherein said solution comprises at least one
2 selected from the group consisting of iodine, bromine, fluorine, HI, KIO₃, sulfuric
3 acid, hydrochloric acid and carbonic acid.

1 8. The slurry of claim 1, wherein a pH of said slurry is from 1 to 13.

1 9. The slurry of claim 1, further comprising at least one etchant for
2 removing a copper or silver oxide or a carbon containing film disposed on or in
3 contact with said copper or silver film.

1 10. The slurry of claim 9, wherein said etchant comprises an acid.

1 11. The slurry of claim 10, wherein said acid comprises at least one
2 selected from the group consisting of nitric acid, acetic acid, sulfuric acid, hydroxy

3 acid, hydrochloric acid, hydrofluoric acid, carboxylic acid, citric acid, malic acid,
4 malonic acid, succinic acid, phtalic acid, tartaric acid, dihydroxysuccinic acid, lactic
5 acid, malic acid, fumaric acid, adipic acid, glutaric acid, oxalic acid, benzoic acid,
6 propionic acid, butyric acid, EDTA and valeric acid.

1 12. The slurry of claim 1, wherein said soft layer is at least one selected
2 from the group consisting of copper or silver bromide, copper or silver fluoride,
3 copper or silver chloride, copper or silver carbonate, copper or silver sulfate and
4 copper or silver nitrate.

1 13. The slurry of claim 1, further comprising at least one passivating
2 additive.

1 14. The slurry of claim 13, wherein said passivating additive is at least
2 one selected from the group consisting of BTA and TTA.

1 15. The slurry of claim 1, further comprising at least one salt.

1 16. The slurry of claim 15, wherein said salt is at least one selected from
2 the group consisting of KI, KBr, KCO₃, NH₄I, KCl and NH₄Cl.

1 17. The slurry of claim 1, further comprising at least one chelating agent.

1 18. The slurry of claim 17, wherein said chelating agent is at least one

2 selected from the group consisting of EDTA, en, acac, phen and oxalate ions.

1 19. The slurry of claim 1, wherein a selectivity of a CMP process using

2 said slurry is at least 100 for removal of said copper or silver film relative to a layer

3 comprising tantalum or titanium.

1 20. The slurry of claim 19, wherein said selectivity is at least 500.

1 21. The slurry of claim 1, wherein a selectivity of a CMP process using

2 said slurry is at least 50 for removal of said copper or silver film relative to a silicon

3 dioxide, alumina or a low K dielectric layer.

1 22. The slurry of claim 21, wherein said selectivity is at least 80.

1 23. The slurry of claim 21, wherein said selectivity is at least 500.

1 24. The slurry of claim 1, further comprising at least one surfactant.

1 25. The slurry of claim 24, wherein said surfactant is at least one selected
2 from the group consisting of non-ionic, anionic, cationic and zwitterionic
3 surfactants.

1 26. The slurry of claim 25, wherein said surfactant is at least one selected
2 from the group consisting of SDS, SAS, CTAB, TRITON X-100® AND TWEEN-80®,
3 KETJENLUBE 522® and CTAC.

1 27. The slurry of claim 1, further comprising at least one polymer additive.

1 28. The slurry of claim 27, wherein said polymer additive is at least one
2 selected from the group consisting of polyethylene oxide (PEO), polyacrylic acid
3 (PAA), polyacryamide (PAM), polyvinylalcohol (PVA) and polyalkylamine (PAH).

1 29. The slurry of claim 1, wherein said slurry is a non-aqueous slurry.

1 30. The slurry of claim 1, wherein a thickness of said soft layer is less
2 than about 1 µm.

1 31. The slurry of claim 1, wherein a thickness of said soft layer is less
2 than about 0.2 µm.

1 32. The slurry of claim 1, wherein said soft layer is substantially insoluble
2 in said slurry.

1 33. A slurry for chemical mechanical polishing (CMP) of a copper or silver
2 containing film, comprising:

3 a solution providing at least one reagent for reacting with said copper or
4 silver film to form a soft layer on a surface of said film, said soft layer having a
5 hardness less than said copper or silver film, said slurry adapted to polish said soft
6 layer using a plurality of abrasive particles being harder than said copper or silver
7 film, a concentration of said abrasive particles being less than 1% by weight.

2 34. The slurry of claim 33, wherein said concentration of said abrasive
 particles is less than approximately 0.1% by weight.

1 35. The slurry of claim 33, wherein said abrasive particles comprise at
2 least one selected from the group consisting of silica, alumina, zirconia, carbon and
3 yttria.

1 36. A slurry for chemical mechanical polishing (CMP) of a structure
2 including a copper or silver film and a silicon dioxide, alumina or a low K dielectric

3 film, wherein said slurry provides a selectivity for a CMP process of at least 200 for
4 removal of said copper or silver film relative to said dielectric film.

1 37. A slurry for chemical mechanical polishing (CMP) of a structure
2 including a copper or silver film and a titanium or tantalum based barrier film,
3 wherein said slurry provides a selectivity for a CMP process of at least
4 approximately 200 for removal of said copper or silver film relative to said barrier
5 film.

2 38. A method for chemical mechanical polishing (CMP) a copper or silver
3 containing film, comprising the steps of:

3 providing a slurry, said slurry providing at least one reagent for reacting with
4 said copper or silver film to form a soft layer on a surface of said copper or silver
5 film, said soft layer having a hardness less than said copper or silver film, said
6 slurry consisting of either no particles or particles which are softer than said copper
7 or silver film,

8 applying said slurry solution to said copper or silver film to form said soft
9 layer, and

10 removing said soft layer using a polishing pad.

1 39. A method for chemical mechanical polishing (CMP) a copper or silver
2 containing film, comprising the steps of:

3 providing a slurry, said slurry providing at least one reagent for reacting with
4 said copper or silver film to form a soft layer on a surface of said copper or silver
5 film, said soft layer having a hardness less than said copper or silver film, said
6 slurry consisting of either no particles or particles which are softer than said copper
7 or silver film,

8 applying said slurry solution to said copper or silver film to form said soft
9 layer, and

10 removing said soft layer using a polishing pad, wherein a selectivity of said
11 CMP process is at least 100 for removal of said copper or silver film relative to a
12 silicon dioxide, alumina or low K dielectric layer.

1 40. A method for chemical mechanical polishing (CMP) a copper or silver
2 containing film, comprising the steps of:

3 etching a surface layer comprising a copper or silver oxide;
4 initiating a CMP process following said etching step, said CMP process
5 comprising:
6 providing a slurry, said slurry providing at least one reagent for reacting with
7 said copper or silver film to form a soft layer on a surface of said copper or silver
8 film, said soft layer having a hardness less than said copper or silver film, said

9 slurry consisting of either no particles or particles which are softer than said copper
10 or silver film,
11 applying said slurry solution to said copper or silver film to form said soft
12 layer, and
13 removing said soft layer using a polishing pad.

1 41. The method of claim 40, wherein said etching step includes at least
2 one etchant selected from the group consisting of nitric acid, acetic acid, sulfuric
3 acid, hydrochloric acid, hydrofluoric acid, hydroxy acid, carboxylic acid, citric acid,
4 malic acid, malonic acid, succinic acid, phthalic acid, tartaric acid, dihydroxysuccinic
5 acid, lactic acid, malic acid, fumaric acid, adipic acid, glutaric acid, oxalic acid,
6 benzoic acid, propionic acid butyric acid, EDTA and valeric acid.

1 5000
2 4000
3 3000
4 2000
5 1000
6 100
1 42. The method of claim 40, wherein a selectivity of said CMP process is
2 at least 100 for removal of said copper or silver film relative to a silicon dioxide,
3 alumina or low K dielectric layer.

1 43. A method for chemical mechanical polishing (CMP) a copper or silver
2 containing film, comprising the steps of:
3 providing a slurry, said slurry including at least one reagent for reacting with
4 said copper or silver film to form a soft layer on a surface of said copper or silver

5 film, said soft layer having a hardness less than said copper or silver film, said
6 slurry comprising a plurality of abrasive particles, said plurality of abrasive particles
7 being harder than said copper or silver film, the concentration of said particles
8 being no more than 1% by weight of said slurry,
9 applying said slurry solution to said copper or silver film to form said soft
10 layer, and
11 removing said soft layer using a polishing pad.

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